Application No.: 10/725,339

IN THE SPECIFICATION:

Please amend the paragraph beginning on page 11, line 12, as follows:

~~Fig. 1 is a schematic plan view of a fuel cell in a first embodiment of the invention, where reaction gas and cooling water flowing in channels of a plate are represented in a perspective view;~~

~~Fig. 2 is a schematic plan view of a fuel cell in a second embodiment of the invention, where reaction gas and cooling water flowing in channels of a plate are represented in a perspective view;~~

~~Fig. 3 is a schematic plan view of a fuel cell in a third embodiment of the invention, where reaction gas and cooling water flowing in channels of a plate are represented in a perspective view;~~

Fig. 1(a) is a plan view of a first plate (plate 1) mounted in a fuel cell stack according to an embodiment of the present invention viewed from the side of the fuel gas channels;

Fig. 1(b) is a plan view of a first plate (plate 1) mounted in a fuel cell stack viewed from the side of the water channels;

Fig. 1(c) is a plan view of a second plate (the other plate) mounted in a fuel cell stack viewed from the side of the air channels;

Fig. 1(d) is a plan view of a second plate (the other plate) mounted in a fuel cell stack viewed from the side on which no gas channels are formed;

Fig. 2(a) is a plan view of a first plate (plate 1) mounted in a fuel cell stack according to an embodiment of the present invention viewed from the side of the fuel gas channels;

Fig. 2(b) is a plan view of a first plate (plate 1) mounted in a fuel cell stack viewed from the side of the water channels;

Fig. 2(c) is a plan view of a second plate (the other plate) mounted in a fuel cell stack viewed from the side of the air channels;

Fig. 2(d) is a plan view of a second plate (the other plate) mounted in a fuel cell stack viewed from the side on which no gas channels are formed;

Fig. 3(a) is a plan view of a first plate (plate 1) mounted in a fuel cell stack according to an embodiment of the present invention viewed from the side of the fuel gas channels;

Fig. 3(b) is a plan view of a first plate (plate 1) mounted in a fuel cell stack viewed from the side of the water channels;

Fig. 3(c) is a plan view of a second plate (the other plate) mounted in a fuel cell stack viewed from the side of the air channels;

Fig. 3(d) is a plan view of a second plate (the other plate) mounted in a fuel cell stack viewed from the side on which no gas channels are formed;

Please amend the paragraph beginning on page 12, line 21, as follows:

Fig. 1 is a plan view of a fuel cell according to the invention in a first embodiment, where the reaction gas and cooling water flowing in corresponding channels arranged in a plate are schematically represented in a perspective view. In Fig. 1, reference numeral 1 means the plate typically made of carbon, where a plurality of concave groove-shaped gas channels 2 is formed on one surface of the plate so as to align in the up/down direction (the direction of gravity) and a plurality of concave groove-shaped water channels 7B (7B is shown in Fig. 1(b)) is formed on the other surface of the plate so as to align in the up/down direction (the direction of gravity) [[so

as]] to [[face]] <u>be back to back</u> each other. The gas inlet header 4 is defined as an area where a reaction gas (fuel gas ~~or oxidant gas~~) supplied in a distributed state from the gas supply manifold hole 3 is further supplied to the inlet of the gas channels 2 (the same definition is applied in the following).

Please amend the paragraph beginning on page 13, line 24, as follows:

On the upper right side of the plate 1 (the side opposite to the gas supply manifold hole 3), a water supply manifold hole 7 is disposed so as to pass through the plate, and the water supply manifold hole 7 is connected to a water inlet header <u>7A (7A is shown in Fig. 1(b))</u> in the concave form, which is disposed on the other surface of the plate 1. The water inlet header <u>7A (7A is shown in Fig. 1(b))</u> is further connected to the inlet of the water channels <u>7B (7B is shown in Fig. 1 (lb))</u>. In this case, the gas inlet header 4 and the water inlet header <u>7A (7A is shown in Fig. 1(b))</u> are disposed respectively on the one surface and the other surface of the plate 1 [[so as]] to [[face]] <u>be back to back</u> each other.

Please amend the paragraph beginning on page 14, line 5, as follows:

Moreover, a water outlet header <u>7C (7C is shown in Fig. 1(b))</u> in the concave form is disposed at the outlet of the water ~~channel~~ <u>channels 7B(7B is shown in Fig. 1(b))</u> in the plate 1, and the water outlet header <u>7C (7C is shown in Fig. 1(b))</u> is connected to a water discharge manifold hole 8, which is disposed on the lower right side of the plate 1 (on the side opposite to the gas discharge manifold hole 6) so as to pass therethrough. As a result, the water supplied from the end portion of the fuel cell stack (in this case, cooling water) is supplied and distributed to the water inlet header <u>7A (7A is shown in Fig. 1(b))</u> of the plate 1 in the respective cells through the water supply manifold 7, which is aligned in the stacking direction of the fuel cell

stack. The supplied water is distributed in water channels 7B (7B is shown in Fig. 1(b)) from the water inlet header 7A (7A is shown in Fig. 1(b)) and is supplied from top to bottom along the water channels 7B (7B is shown in Fig. 1(b)), and then discharged into the water outlet header 7C (7C is shown in Fig. 1(b)), and further flows into the water discharge manifold hole 8, which is aligned in the stacking direction of the fuel cell stack. Finally, the water is discharged to the outside from the end portion of the fuel cell stack after passing through the water discharge manifold hole 8.

Please amend the paragraph beginning on page 14, line 20, as follows:

On the other hand, a plurality of gas channels 2'(2'is shown in Fig. 1(c)) corresponding to the gas channels 2 in the plate 1 is disposed from top to bottom (in the direction of gravity) in the other plate. A gas inlet header 4' in the concave form is connected to the inlet of the gas channels 2'(2'is shown in Fig. 1(c)) and a gas outlet header 5' in the concave form is connected to the outlet of the gas channels 2' (2'is shown in Fig. 1(c)). As a result, in the other plate, an oxidant gas (In this case, air introduced from the outside air) is supplied to the gas inlet header 4', and distributed into the gas channels 2'(2'is shown in Fig. 1(c)) from the gas inlet header 4'. Then, the oxidant gas flows from top to bottom along the gas channels 2'(2'is shown in Fig. 1(c)), and discharged to the gas outlet header 5', and finally discharged to the outside of the fuel cell stack.

Please amend the paragraph beginning on page 15, line 3, as follows:

A cell is inserted between the gas channels 2 of the plate 1 and the gas channels 2'(2'is shown in Fig. 1(c)) of the other plate, and the composite member thus formed is mounted in the fuel cell stack. In this case, a unit cell is constituted by contacting closely and facing the ~~cathode~~

anode of the cell to the gas channels 2 of the plate 1 and by contacting closely and facing the cathode of the cell to the gas channels 2'(2'is shown in Fig. 1(c)) of the other plate. Then, the fuel cell stack is constituted by stacking the unit cells to form a unit [[unit]] cell. Regarding the gas inlet headers 4, 4', the gas outlet header 5, 5', the water inlet header 7A (7A is shown in Fig. 1(c)) and the water outlet header 7C (7C is shown in Fig. 1(c)), the upper surface of the concave portion is covered by a gasket or the like, thereby enabling the leakage of gas and water to be prevented.

Please amend the paragraph beginning on page 15, line 13, as follows:

In the fuel cell thus constituted, the fuel gas flows in the gas channels 2 of the plate 1 and the oxidant gas flows in the gas channels 2' (2' is shown in Fig. 1(c)) of the other plate. As a result, an electrochemical reaction takes place via the polymer electrolyte membrane of the cell, thereby enabling the DC electric power to be generated.

Please amend the paragraph beginning on page 15, line 17, as follows:

In order to humidify the polymer electrolytic membrane of the cell in the saturated state, the fuel gas is supplied to the fuel cell stack, after it is humidified with, for example, a humidifier at a dew point close to the cell temperature. In the prior art, a wet fuel gas is cooled particularly in the inlet area of the gas channels 2, when it is supplied to the gas channels 2, so that the water vapor contained in the gas is dew condensed to form the dew. As a result, the condensed water is adhered to inside wall of the gas channels 2 and clogs them, thereby causing the flow of the fuel gas to be interrupted. In this embodiment, however, the water inlet header 7A (7A is shown in Fig. 1(c)) is disposed so as to be close to the gas inlet header 4 so as to [[face]] be back to back

each other. As a result, the water inlet header is heated by the cooling water as a heat medium supplied thereto, and the gas inlet header 4 is indirectly heated up by the heat conduction, thereby making it possible to prevent the water vapor contained in the fuel gas from dew condensation.

Please amend the paragraph beginning on page 16, line 11, as follows:

In this embodiment, the cooling water is used as a heat medium for preventing the dew condensation in the fuel gas. However, the oxidant gas can be used for [[a]] the heat medium instead of the cooling water. In this case, the gas inlet header 4' for the oxidant gas is disposed close to the gas ~~outlet~~ inlet header 4 for the fuel gas in the plate 1 on the other [[side]] surface.

Please amend the paragraph beginning on page 16, line 22, as follows:

Fig. 2 is a plan view of a fuel cell according to the invention in a second embodiment, where the reaction gas and cooling water flowing in corresponding channels arranged in a plate are schematically represented in a perspective view. This embodiment is different from the first embodiment as for the point that an inner air manifold system is employed in the second embodiment. In Fig. 2, reference numeral 1 means a plate made of mainly carbon. A plurality of gas channels 2 in the form of concave grooves are disposed from top to bottom (in the direction of gravity) on one surface of the plate 1 and a plurality of water channels 7B (7B is shown in Fig. 2(b)) in the form of concave grooves are disposed from top to bottom (in the direction of gravity) on the other surface of the plate 1 in such a way that the gas channels 2 ~~face~~ and the water channels 7B (7B is shown in Fig. 2(b)) are back to back each other. In this case, a gas supply manifold hole 3 is disposed on the upper left side of the plate 1 in such a way that it

passes through the plate 1, and the gas supply manifold hole 3 is connected to a gas inlet header 4 in the concave form. Moreover, the gas inlet header 4 is connected to the gas channels 2. Such a gas inlet header 4 is generally called as a manifold.

Please amend the paragraph beginning on page 17, line 24, as follows:

In addition, a water supply manifold hole 7 is disposed on the upper right side of the plate 1 (on the side opposite to the gas supply manifold hole 3). The water supply manifold hole 7 is connected to the water inlet header 7A (7A is shown in Fig. 2(b)) in the form of a concave shape, which is disposed on the other surface of the plate 1, and the water inlet header 7A (7A is shown in Fig. 2(b)) is connected to the inlet of the water channels 7B (7B is shown in Fig. 2(b)).

Please amend the paragraph beginning on page 18, line 2, as follows:

Moreover, a water outlet header 7C (7C is shown in Fig. 2(b)) in the concave form is disposed in the outlet of the channels on the other surface of the plate 1, and the water outlet header 7C (7C is shown in Fig. 2(b)) is connected to a water discharge manifold hole 8, which is disposed on the lower right side of the plate 1 (on the side opposite to the gas discharge manifold hole 6) so as pass therethrough. As a result, water (cooling water), which is supplied from the end portion of the fuel cell stack, is supplied and distributed to the water inlet header 7A (7A is shown in Fig. 2(b)), in the plate 1 of each cell via the water supply manifold hole 7 aligned in the stacking direction of the fuel cell stack, and the water is further distributed from the water inlet header 7A to the water channels 7B (7B is shown in Fig. 2(b)). Thereafter, the water flows from top to bottom along the water channels 7B (7B is shown in Fig. 2(b)), and it is discharged to the water outlet header 7C (7C is shown in Fig. 2(b)) and then flows into the water discharge

manifold hole 8 aligned in the stacking direction of the fuel cell stack. Finally, the water is discharged to the outside from the end portion of the fuel cell stack via the water discharge manifold hole 8.

Please amend the paragraph beginning on page 18, line 16, as follows:

On the other hand, a plurality of gas channels 2'(2'is shown in Fig. 2(c)) corresponding to the gas channels 2 in the plate 1 are arranged from top to bottom (in the direction of gravity) in the other plate. In this case, a gas supply manifold hole 3' is disposed on the upper right side of the other plate so as to pass therethrough, and the gas supply manifold hole 3' is connected to a gas inlet header 4' (4'is shown in Fig. 2(c)) in the concave form, and further the gas inlet header 4' (4'is shown in Fig. 2(c)) is connected to the gas channels 2'(2'is shown in Fig. 2(c)).

Please amend the paragraph beginning on page 18, line 23, as follows:

The outlet of the gas channels 2' (2'is shown in Fig. 2(c)) in the other plate is connected to the gas outlet header 5' (5'is shown in Fig. 2(c)) in the concave form, which is disposed in the lower part of the plate, and the gas outlet header 5'(5'is shown in Fig. 2(c)) is further connected to a gas discharge manifold hole 6', which is disposed in the lower end of the other plate so as pass therethrough. As a result, oxidant gas (air) supplied from the end portions of the fuel cell stack is supplied and distributed to the gas inlet header 4'(4'is shown in Fig. 2(c)) on the other plate in each cell via the gas supply manifold hole 3' aligned in the stacking direction of the fuel cell stack, and then distributed to the gas channels 2'(2'is shown in Fig. 2(c)) from the gas inlet header 4'(4'is shown in Fig. 2(c)). The oxidant gas thus distributed flows from top to bottom along the gas channels 2'(2'is shown in Fig. 2(c)), and it is discharged to the gas outlet header

5'(5'is shown in Fig. 2(c)). Thereafter, the oxidant gas flows into the gas discharge manifold hole 6' aligned in the stacking direction of the fuel cell stack and is discharged from the end portion of the fuel cell stack to the outside via the gas discharge manifold hole 6'.

Please amend the paragraph beginning on page 19, line 10, as follows:

Similarly to the first embodiment, each cell is inserted between the gas channels 2 in the plate 1 and the gas channels 2' (2'is shown in Fig. 2(c)) in the other plate, and the composite elements obtained after the insertion are mounted in the fuel cell stack. In this case, an anode in the cell faces the gas channels 2 in the plate 1 and contacts closely thereto, and a cathode in the cell faces the gas channels 2' (2'is shown in Fig. 2(c)) in the other plate and contacts closely thereto, so that a unit cell is formed. The fuel cell stack is produced by stacking such unit cells to form a unit. In this case, the gas inlet header 4, gas outlet header 5, water inlet headers 7A (7A is shown in Fig. 2(b)) and the water outlet header 7C (7C is shown in Fig. 2(b)) are covered on their concave upper surface by a gasket or the like, so that the leakage is prevented.

Please amend the paragraph beginning on page 19, line 20, as follows:

In the fuel cell stack thus formed in the second embodiment, the fuel gas flows into the gas channels 2 of the plate 1 and the oxidant gas flows into the gas channels 2'(2' is shown in Fig. 2(c)) of the other plate, so that the electrochemical reaction takes place via the polymer electrolyte membrane of the cell, thereby enabling a DC electric power to be generated.

Please amend the paragraph beginning on page 19, line 25, as follows:

As described above, in order to humidify the polymer electrolyte membrane of the cell in the saturated state, a fuel gas is supplied to the fuel cell stack after humidified with, for example, a humidifier such that the dew point is close to the cell temperature. In the second embodiment, the water inlet header <u>7A (7A is shown in Fig. 2(b))</u> is disposed such that it is close to the gas inlet header 4 on the other [[side]] <u>surface</u>, so that the water inlet header <u>7A (7A is shown in Fig. 2(b))</u> is heated by the cooling water supplied thereto, and the gas inlet header 4 is indirectly heated by the heat conduction, thereby making it possible to prevent the water vapor contained in the fuel gas from condensing. Accordingly, the clogging of the fuel gas due to the condensed water can be suppressed, and a normal operation in the generation of the electric power is ensured, thereby enabling high performance of the cell to be maintained.

Please amend the paragraph beginning on page 20, line 21, as follows:

In the second embodiment, the cooling water is also used as a heat medium for preventing the dew condensation of the fuel gas. However, the oxidant gas can be used as [[a]] <u>the</u> heat medium instead of the cooling water. In this case, the gas inlet header <u>4'(4'is shown in Fig. 2(c))</u> for the oxidant gas is disposed close to the gas ~~outlet~~ <u>inlet</u> header 4 for the fuel gas in the plate 1 on the other [[side]] <u>surface</u>, although the arrangement is not shown, and water channels for supplying the cooling water are disposed in the other plate. Furthermore, in order to prevent the dew condensation of the fuel gas by the oxidant gas (air), the temperature of the air inlet is set such that the dew point of the fuel gas ≤ the temperature of the air.

Please amend the paragraph beginning on page 22, line 24, as follows:

Aside from the water supply manifold hole 7, a second water supply manifold holc 10 is disposed in the plate 1 so as to pass therethrough. Cooling water is supplied from the second water supply manifold holc 10, and in the water channels 10B (10B is shown in Fig. 3(b)) on the other surface of the plate 1, the cooling water is introduced into an area located somewhat downstream from the flow resistance generation section 9. A difference between the second and the third embodiments also resides in such a structural arrangement.

Please amend the paragraph beginning on page 23, line 4, as follows:

Moreover, a second water discharge manifold hole 11 is disposed on the upper left side of the plate 1 (on thc side opposite to the water supply manifold hole 7) so as to pass therethrough, and it is connected to the water inlet header 10A (10A is shown in Fig. 3(b)). In this case, the watcr inlet header 10A (10A is shown in Fig. 3(b)) is separated from the inlet of thc water channels 10B (10B is shown in Fig. 3(b)) for supplying the cooling water by disposing a partition wall (not shown) in the interface to the inlet of the water channels. A difference between the second and the third embodiments also resides in such a structural arrangement.

Please amend the paragraph beginning on page 23, line 12, as follows:

In the third embodiment, the cooling water is supplied from the second water supply manifold hole 10 to the water channels 10B (10B is shown in Fig. 3(b)) in the plate 1, and the flows from top to bottom in the water channels 10B (10B is shown in Fig. 3(b)). Thereafter, the cooling water is discharged from the outlet of the water channels 10B (10B is shown in Fig. 3(b)) to the water supply manifold hole 8, and it is further supplied from the water discharge manifold hole 8 to the water supply manifold hole 7. Moreover, the cooling water is supplied to the water

inlet header 10D (10D is shown in Fig. 3(b)) and discharged from the water inlet header 10D (10D is shown in Fig. 3(b)) to the second water discharge manifold hole 11, and then flows in the stacking direction of the fuel cell stack, and finally discharged from the end portion of the fuel cell stack to the outside.

Please amend the paragraph beginning on page 23, line 22, as follows:

In the above water circulating channel, the means for supplying the cooling water from the water discharge manifold hole 8 to the water supply manifold hole 7 can be realized, for example, by concave groove-shaped channels (not shown) which are connected to the water discharge manifold hole 8 and to the water supply manifold hole 7 on the other surface of the plate 1, or by a tube-shaped connection channel disposed either in the end plate of the fuel cell stack or outside the fuel cell stack such that the water discharge manifold hole 8 is connected to the water supply manifold hole 7. In this case, the cooling water is supplied in the water channels 10B (10B is shown in Fig. 3(b)) in the plate 1 and then returned to the water supply header 10D (10D is shown in Fig. 3(b)) in the plate 1.

Please amend the paragraph beginning on page 24, line 5, as follows:

The reason why the cooling water is supplied from the second water supply manifold hole 10 is due to the fact that the polymer electrolyte membrane in the cell connecting to the gas channel 2 is humidified and maintained in the saturated moist state, in which case, the cooling water cools the inlet area for the water channels 10B (10B is shown in Fig. 3(b)), and further cools the inlet area for the gas channels 2 facing the water channels 10B (10B is shown in Fig. 3(b)) on the other [[side]] surface, so that the dew point of the fuel gas is lowered when the fuel

gas is introduced into the gas channels 2, and thereby the water vapor contained in the fuel gas is compulsively condensed.

Please amend the paragraph beginning on page 24, line 14, as follows:

Furthermore, the reason why the cooling water passed through the water channels in the plate 1 is again returned to the water supply header 10D (10D is shown in Fig. 3(b)) is due to the fact that the area surrounded by the broken line in FIG. 3 is warmed up, in which case, the flow resistance generation section 9 is disposed in an area facing the above-mentioned area on the other surface, and the flow resistance generation section 9 is warmed up by the heat conduction, so that the dew condensation in the nozzle holes 9 is prevented.